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# (12) United States Patent

### Rivera et al.

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#### (54) SHEAR PIN FAILURE SYSTEM

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#### (56) References Cited

#### U.S. PATENT DOCUMENTS

7,946,376	B2	5/2011	Hayashi et al.	
9,205,794	B1*	12/2015	Farooq	B60R 19/18
2005/0212327	A1*	9/2005	Schramm	B60R 21/34
				296/187.04

#### FOREIGN PATENT DOCUMENTS

EP	2607179	B1		11/2014
JP	2004026027	Α	×	1/2004
WO	2004113131	A1		12/2004

#### \* cited by examiner

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#### (57) ABSTRACT

Aspects of the disclosure relate to adjusting a shear pin to minimize an impact force felt by an object in a collision with a vehicle. For example, one or more second computing devices may receive, from one or more first computing devices, information indicating that an impact with an object is imminent. In response to the received information, the second computing devices may determine a first shear force for a first shear pin, wherein the first shear force is a desired amount of shear force necessary to break the first shear pin. The second computing devices may send a triggering signal to activate an actuator prior to an impact with the identified impact target. The actuator, in response to receiving the triggering signal, may adjust the first shear pin in a first pinhole, so the first shear pin will break at the first shear force.

#### 20 Claims, 10 Drawing Sheets

